A.H.D. No. 133 July 1950

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Animal Industry

RECENT DEVELOPMENTS IN POULTRY FEEDING

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In some respects the job of the manufacturer of poultry feed is becoming more and more complex. Certainly no one will argue with that statement. But there may be some argument when I say that in other respects his job is becoming more and more simple. To support this statement, let me remind you that just a few years ago it was considered necessary that a good starting mash for chicks contain several grains or grain byproducts and several protein supplements, including one milk byproduct. By way of contrast, some chicks in our laboratory recently set new records for their particular strain of Rhode Island Reds for rapid growth and high feed efficiency on a diet containing 65 percent of yellow corn, 30 percent of soybean meal, 3.7 percent of mineral supplements, and 1.3 percent of vitamin supplements. We are not ready to recommend such a diet for commercial use because we believe that all poultry diets should contain some alfalfa and that the diets of starting chicks, commercial broilers, and breeders should contain at least a small amount of animal protein supplement. However, the incident illustrates the trend toward successful simplified diets. The trend has already progressed to the point where many commercial feeds contain yellow corn as the only grain, with a large quantity of soybean meal and a small quantity of fish or meat meal as the only protein supplements. It is only reasonable to expect that this trend will continue and that some time in the future it will be possible to use any one of several grains as the chief source of energy with any one of several protein supplements, and that it will be possible to supply each of the required vitamins cheaply in the form of special concentrates and to add in synthetic form whatever amino acids are not adequately supplied by the source of protein.

Research on vitamin requirements of poultry has taken much of the hocus-pocus out of the manufacture of poultry feeds. It was formerly necessary to use several grains and several protein supplements because such complex mixtures were less likely to be deficient in unknown dietary factors than were simpler mixtures. The feed manufacturer who must choose from today's long and varied list of feedstuffs may sometimes sigh for the good old days and the hocus-pocus, but the wider choice of ingredients that is now possible and the simpler formulas have made the job of feed formulation easier for the man who knows the rules. The rules of the game are more numerous than they were ten years ago, but they are also more exact and therefore more useful.

The demonstration of the importance of riboflavin in poultry feeds was not a recent development but it deserves mention here because it was an important early step in the simplification of formulas. It made the poultry feed manufacturer independent of milk byproducts. We still recognize the nutritive value of these materials, and one of them, dried whey, is widely used in poultry feeds. But it does not have to be used. It is one of several materials the manufacturer may choose.

Presented at the annual meeting of the Eastern Federation of Feed Merchants, Inc., at New York City on June 13, 1950

During the last ten years, experiments with purified diets have shown that chickens need several water-soluble vitamins besides riboflavin. Some of these are supplied in large enough quantities by grains and protein supplements so that they do not have to be supplied as special supplements and so are of little concern to the feed industry. Two of them, nicotinic acid and choline, are added in synthetic form to high-efficiency diets containing corn as the only grain. Lack of sufficient nicotinic acid in high-corn diets undoubtedly was part of the reason for the failure of such diets in the past and for the recommendation that several grains be used.

During the same time that the requirements for nicotinic acid and choline were being established, several laboratories were finding that there was another still-unknown vitamin, the practical importance of which promised to rival that of riboflavin. This new factor was found among commercial feedstuffs only in animal byproducts and realization of this fact stimulated the demand for these products to the extent that it often exceeded the supply. Because of the distribution of the vitamin, it came to be called the "animal protein factor." This unknown vitamin was found to be present in the manure of cows and chickens, and experiments on chicken manure indicated very clearly that bacterial synthesis accounted for the presence of the vitamin. This finding suggested that supplements containing the vitamin might be produced commercially by fermentation. It was not long before this was accomplished. At about the same time a new growth factor required by certain bacteria was isolated in pure form and designated vitamin B_{12}. Pure vitamin B_{12} was as effective in supporting growth of chickens as were concentrates prepared from cow manure, and it proved to be required for hatchability also. In some dietary combinations soybean meal plus B_{12} was equal to high quality fish meal. In others soybean meal plus B_{12} was much better than soybean meal alone, but still not quite as good as fish meal. On the basis of such results there was general acceptance of the view that the "animal protein factor" was a complex of which B_{12} was the most important part but not the only part.

The search for new sources of vitamin B_{12} led to the finding that the organisms used commercially to produce the antibiotics, aureomycin and streptomycin, also produced considerable quantities of vitamin B_{12} which could be recovered as a byproduct. Next it was found that a certain byproduct derived from the manufacture of aureomycin promoted growth at a faster rate than did pure vitamin B_{12}. At first it was thought that one of the still-unknown factors present in animal products was also present in this fermentation product, and the growth stimulation was described as the effect of A.P.F., meaning B_{12} plus some other factor or factors supplied by animal byproducts. However, within the last few months, research workers of Lederle Laboratories have shown that that portion of the growth stimulation which is not due to B_{12} is due to aureomycin remaining in the product. Since any one of three other antibiotics; streptomycin, penicillin, or terramycin; works just as well, we may assume that the effect is due to the characteristic shared by all these compounds, namely, their effect on bacterial growth, presumably in the intestinal tract.

When it was first reported that there was in the aureomycin byproduct an unknown growth factor besides B_{12}, the thought occurred to us that the "unknown" might be the antibiotic itself. It had been reported earlier that certain organic arsenic compounds stimulated growth of chickens, and we had studied these compounds. Their effect on the intestinal bacteria had been suggested

as a possible explanation of their stimulation of growth. It seemed logical to compare a combination of B_{12} and the arsenic compound with a product containing B_{12} and aureomycin. The two combinations were about equally effective, and it looked as though the arsenic compound and aureomycin were performing the same function. But when we fed B_{12}, the arsenic compound, and aureomycin together, the effect was greater than when any two were fed. Therefore, all three must perform different functions. These three compounds were included in the diet mentioned at the beginning of this report, the diet that supported the fastest growth we have yet been able to obtain in our strain of Rhode Island Reds.

Thus far, I have attempted to show how vitamin B_{12}, antibiotics, and organic arsenic compounds reached their present important positions as new developments in poultry feeding. You certainly will wish to ask what effect these developments will have on your business. In discussing this subject, it is important to make a distinction between vitamin B_{12} and antibiotics. Successful starting mashes and breeder mashes always contained vitamin B_{12} even when we didn't know of the existence of the vitamin. But they did not always contain antibiotics. In that case, something new has been added.

Vitamin B_{12} is required for early growth and reproduction of poultry and swine. The diet of young chickens should contain enough animal protein supplement or other source of vitamin B_{12} to supply 7 to 10 micrograms of the vitamin per pound of feed. The requirement of young growing pigs has been reported to be in the same range. The level needed to permit normal reproduction in chickens is somewhat less.

Vitamin B_{12} requirements for reproduction and early growth are very closely related. Sufficient carry-over from maternal diet to offspring is perhaps more important than in the case of any other nutrient. Chicks hatched from the eggs of hens fed a deficient diet feather poorly, grow slowly, and show high mortality. The tendency to slow growth can be very largely overcome by supplying enough of the vitamin in the chicks' diet, but the high mortality and poor feathering cannot be corrected very readily by this means. Mortality can be reduced and feathering improved by supplying the vitamin in the hens' diet. The chicks of deficient hens come out of the shell with a deficit of the vitamin so severe that it cannot be overcome by feeding a good diet. The manufacturer of a breeder mash therefore has an obligation not only to the poultry breeder and hatchery operator who depend upon him for a mash that will support a high level of egg production and hatchability, but also to the purchaser of the chicks, the quality of which may be greatly influenced by the diet of their dams.

Until about a year ago, most of the vitamin B_{12} that went into commercial feeds was supplied by fish meal and solubles and meat meal. It has been estimated that the quantity of the vitamin available from these sources was less than half the quantity needed for poultry and swine. The new supplements produced by fermentation have greatly increased the supply of the vitamin. This does not mean that fish meal and meat meal are out of date. We have great need of their protein and can still make good use of the calcium, phosphorus, riboflavin, and vitamin B_{12} they supply. However, the availability of other sources of B_{12} has undoubtedly brought prices of animal byproducts and soybean meal closer together than they used to be.

Until recently, starting and growing mashes probably often contained less than the desired quantity of vitamin B_{12}. It is believed, therefore, that new sources of the vitamin at lower cost will have the general effect of increasing quality and decreasing cost of starting and growing mashes. In breeder mashes, the value of high-quality animal protein supplements was so well recognized in the past that they were included almost without regard to price. The new supplements may therefore have little effect in improving quality of breeder mashes but should reduce cost. There is no reason to suppose that the new supplements will improve the quality of egg mashes since egg production is maintained very satisfactorily on diets composed largely of corn and soybean meal with no animal products or other B_{12} supplements.

No one can predict now the effect of antibiotics and organic arsenic compounds on the feed industry. Some of the vitamin B_{12} supplements on the market contain an antibiotic. If I were buying a B_{12} supplement for use in a broiler mash, I would certainly choose a supplement that contained an antibiotic in preference to one without. Beyond that, we are not ready to make any recommendations. The quantity of antibiotic needed to produce the best results in a chick diet is 7 to 10 milligrams per pound of feed. This is 1,000 times the required level of vitamin B_{12}. The quantity of the organic arsenic compound required for the maximum effect is 20 to 25 milligrams per pound of feed. You may be wondering what effect the continuous feeding of an antibiotic during the growing period will have upon the productiveness of a pullet in the laying house, what effect the feeding of antibiotics will have on the chemical and biological changes that occur in poultry manure and litter, and what effect dietary antibiotics will have on requirements for the known vitamins, some of which are manufactured in significant quantities by bacteria in the digestive tract and in the litter. The answers to these questions are still to be determined. Some experiments on the feeding of aureomycin to laying hens have indicated that it does not improve egg production or hatchability. Feeding it to hens does not benefit their chicks. Its effects are not carried over as are the effects of vitamin B_{12}.

Perhaps you are wondering what the term "animal protein factor" means in the light of these recent developments. Surely, we can not call aureomycin an animal protein factor. Therefore, it would seem that the products derived from fermentation are not A.P.F. supplements, but B_{12}-antibiotic supplements. It is hard to believe that fish meal, meat meal, or fish solubles contain antibiotics, so we must continue to believe that they contain some unknown dietary factor or factors in addition to vitamin B_{12}. We are still being conservative and recommending that broiler mashes contain at least 4 percent of fish meal or 8 percent of meat meal and that starting mashes for flock-replacement chicks and all-mash breeder diets contain at least 2 percent of fish meal or 4 percent of meat meal. These quantities would supply about one-half the required level of B_{12} for broilers and breeders and about one-fourth the level for chicks intended for flock-replacement. It is assumed, of course, that the rest of the required B_{12} would be supplied as a B_{12} supplement.

Chick diets composed largely of corn and soybean meal with little or no animal protein supplement but with ample B_{12} can be improved somewhat from the standpoint of growth by the addition of 0.1 percent of the amino acid, methionine. Methionine is present in the proteins of feeds but many diets for chicks do not supply quite enough. Some synthetic methionine is now being used commercially in feeds. What effect the feeding of antibiotics will have on methionine requirements is not known.

There are other recent developments that properly come under the title of this discussion, but time prevents their inclusion here. It is appropriate to remind you in closing that chickens still need protein, calcium, phosphorus, manganese, salt, vitamins A and D, and riboflavin. The feed industry still has to give attention to these long-recognized nutrients as well as to new developments. As information accumulates on the new developments and they take their place in the above list, more efficient and more economical feeds will surely result.